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Variational Algorithms for Test Particle Trajectories[1] C. LELAND ELLISON, Princeton Plasma Physics Laboratory, JOHN M. FINN, Los Alamos National Laboratory, HONG QIN, WILLIAM M. TANG, Princeton Plasma Physics Laboratory — The theory of variational integration provides a novel framework for constructing conservative numerical methods for magnetized test particle dynamics. The retention of conservation laws in the numerical time advance captures the correct qualitative behavior of the long time dynamics. For modeling the Lorentz force system, new variational integrators have been developed that are both symplectic and electromagnetically gauge invariant. For guiding center test particle dynamics, discretization of the phase-space action principle yields multistep variational algorithms, in general. Obtaining the desired long-term numerical fidelity requires mitigation of the multistep method's parasitic modes or applying a discretization scheme that possesses a discrete degeneracy to yield a one-step method. Dissipative effects may be modeled using Lagrange-D'Alembert variational principles. Numerical results will be presented using a new numerical platform that interfaces with popular equilibrium codes and utilizes parallel hardware to achieve reduced times to solution.

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